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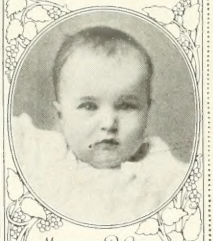

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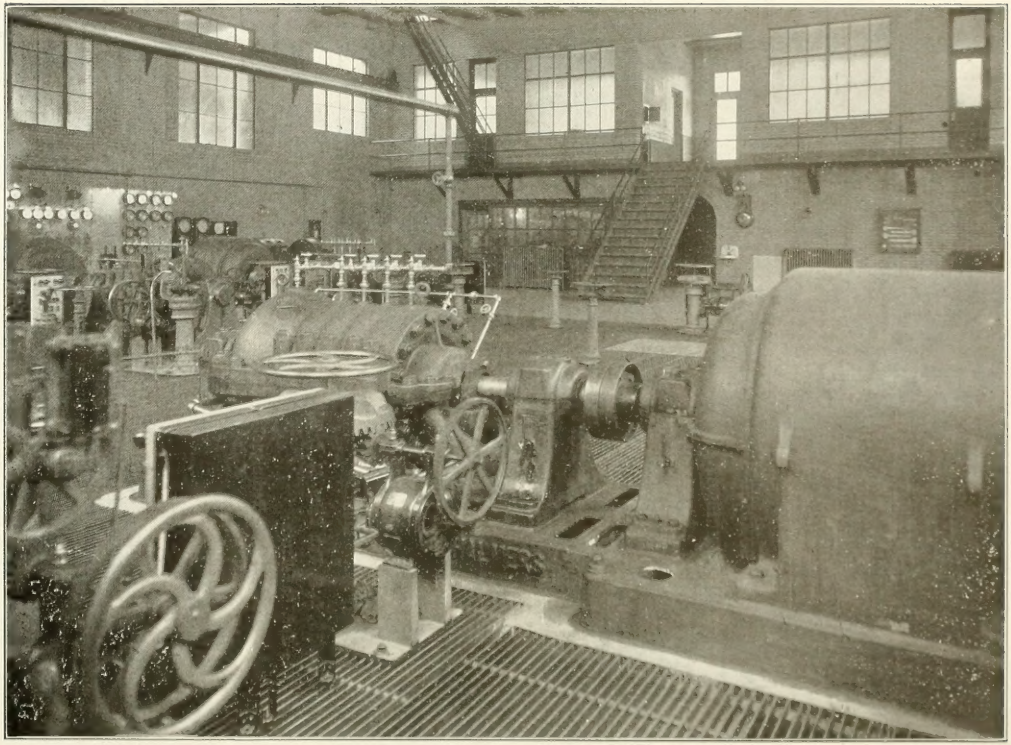

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THE TECHNOLOGY MONTHLY
ENGINEERING JOURNAL

VOL. III CAMBRIDGE, MASS., MARCH, 1917 NO. 8

The Economic Efficiency of a Workman

By Leonard M. Passano

I.

Introduction and Definition

THE productive, or as it may be more accurately called, the speed efficiency of a workman, depends upon the amount of work which he does in a given time. The economic efficiency (E) depends upon the cost of the workman's product, its increase in value, and spoilage. As an article passes from one department of a factory to another, there is an increase in its value due to the labor put into the product, to overhead charges (supposed in what follows to include all expenses except labor and to be properly allocated to the various departments or shops) and, perhaps, to the demand for the article from possible purchasers or consumers. With the actual selling price of the finished article or with the profit we are not concerned.

The increase in value of a product will be called the *actual gain;* the increase in value that may be expected on a product of given cost will be called the *expectant gain;* and the economic efficiency of a workman is defined as *the ratio of the actual gain on his product to the expectant gain on his product.*

$$E = \frac{\text{Actual gain}}{\text{Expectant gain}}$$

II.

The Theoretical Formulae; Spoilage Treated as Reducing the Product

Let us assume as our data a normal working week of fifty hours, a required factory gain or increase in value of ten per cent, a wage of forty cents per hour, and an overhead burden (including everything but wages) of sixty cents per hour. Suppose a workman, X, who does *a* hours work in fifty hours, works *b* hours, is idle 50-*b* hours and spoils *c* dollars *of his own product.*

We have thus

$$\text{Speed efficiency} = \frac{a}{50} = 2\,a\,\%$$

$$b \text{ working hours} = b \times \frac{a}{50} = \frac{ab}{50} \text{ normal hours}$$

$$\frac{ab}{50} \text{ normal hours @ \$1.} = \frac{ab}{50} \text{ dollars.}$$

$$\text{spoilage} = c \text{ dollars.}$$

$$\text{net product} = \frac{ab}{50} - c \text{ dollars.}$$

$$10\,\% \text{ factory gain} = \frac{ab}{500} - \frac{c}{10} \text{ dollars.}$$

which is the *actual gain.*

The costs are

$$b \text{ working hours @ \$1.} = b \text{ dollars.}$$

$$50\text{-}b \text{ idle hours @ \$ .60} = 30 - \frac{3b}{5} \text{ dollars.}$$

$$\text{total cost} = 30 + \frac{2b}{5} \text{ dollars.}$$

$$10\,\% \text{ factory gain} = 3 + \frac{b}{25} \text{ dollars.}$$

which is the *expectant gain.*

Therefore, by the definition of efficiency,

$$E = \frac{\frac{ab}{500} - \frac{c}{10}}{3 + \frac{b}{25}} = \frac{\frac{ab}{50} - c}{30 + \frac{26}{5}}$$ [1]

If in this formula we put a = b = 50, c = o, we obtain E = 1 or 100 per cent. A man who attains this efficiency produces the required gain of ten per cent[2], a man of fifty per cent efficiency would produce a gain of five per cent, etc. Zero efficiency would mean no gain and a negative value of E would mean a loss.

Assume the following data: a=100, b=25, c=o. We obtain E=125%. This case analyzed independently of the formula gives a speed efficiency $\frac{100}{50} = 200\%$; so that twenty-five working hours equals 25 x 200% 50 normal hours, which at one dollar per hour give fifty dollars, value of product. The gain at 10% is five dollars. The costs are twenty-five hours at one dollar, or twenty-five dollars; twenty-five hours idle time at sixty cents, fifteen dollars; total, twenty-five dollars plus fifteen dollars equals forty dollars. The expectant gain, is ten per cent of forty dollars, or four dollars. The efficiency is therefore, $\frac{\$5.}{\$4.} = 125$ per cent.

Table I illustrates by a unmber of examples the relative effect of idle time and spoilage, and gives a comparison of efficiency computed by the writer's definition with speed efficiency.

Case J of table I shows, what is perhaps already sufficiently obvious, that spoilage of a man's own work is equivalent to a reduction of his product. Spoilage of another man's work, or of raw material,

TABLE I.

Workman	a Number of hours' work done in 50 hours	b Number of working hours	c Spoilage in dollars	E True efficiency; per cent.	Speed, or productive, efficiency, per cent.
A	60	49	0	118.5	120
B	60	50	1	118.	120
C	50	45	0	93.8	100
D	50	50	5	90.	100
E	40	45	0	75.	80
F	40	50	5	70.	80
G	40	45	10	54.2	80
H	60	30	1	83.3	120
J	50	50	50	0.	100

must be treated differently. Such a spoilage of *m* dollars means a direct loss, so that the actual gain on the product of the workman to whom the spoilage is chargeable is diminished by just so much. In this case the formula becomes

$$E = \frac{\frac{ab}{500} - \frac{c}{10} - m}{3 + \frac{b}{25}} = \frac{\frac{ab}{50} - c - 10m}{30 + \frac{2b}{5}}$$

Obviously spoilage of another man's work has much greater weight in lowering efficiency than has spoilage of a man's own work. In the former case the total amount of spoilage is a loss, in the latter case the loss consists of the ten per cent gain only.

[1] The second form of the value of E shows that another definition of efficiency might be given; namely, the ratio of value of product to cost of product; a definition analogous to "the ratio of useful work to energy expended." For reasons which will appear later the writer prefers the first form of definition, although he will use the second form of the value of E in making computations.

[2] See section iv, footnote 3 following.

III.

The Theoretical Formulae; Spoilage Treated as Increasing the Cost

Spoilage may be looked at from another very important point of view. In the preceding discussion such spoilage was regarded as diminishing an operative's product by c (or by $10\ m$) dollars.

We shall now consider the c dollars spoilage as *an additional cost* necessary to make the product perfect.

With the same general data as before, we now have

$$\text{value of product} = \frac{ab}{50} \text{ dollars}$$

$$10 \quad \text{factory gain} = \frac{ab}{500} \text{ dollars}$$

which is the *actual gain.*

Costs:

b working hours (a \$1. = b dollars

$50-b$ idle hours (a .60 $= 30 - \frac{3b}{5}$ dollars

$$\text{spoilage} = c \text{ dollars}$$

$$\text{total cost} = 30 + \frac{2b}{5} + c \text{ dollars}$$

$$10\% \text{ factory gain} = 3 + \frac{b}{25} + \frac{c}{10} \text{ dollars}$$

which is the *expectant gain.*

Therefore,

$$E = \frac{\frac{ab}{500}}{3 + \frac{b}{25} + \frac{c}{10}} - \frac{\frac{ab}{50}}{30 + \frac{2b}{5} + c}$$

Computing by this formula the efficiencies of the workmen of table I, we have table II.

It will be noted that in cases where there was no spoilage ($c = 0$) the efficiency is unchanged. Workman J is especially interesting. By the first hypothesis this man's work was all wasted, there was no gain and therefore his efficiency was zero. By the second hypothesis his work was made perfect by the expenditure of fifty more dollars; the normal gain is made at twice the cost, and, therefore, his efficiency is fifty per cent.

TABLE II.

Workman	E per cent. First formula. Spoilage reducing product	E per cent. Second formula. Spoilage increasing cost
A	118.5	118.5
B	118.	117.6
C	93.8	93.8
D	90.	90.9
E	75.	75.
F	70.	72.7
G	54.2	62.1
H	83.3	83.7
J	0	50.

The writer believes that in some trades the treatment of spoilage as diminishing the product may be the proper method; in other trades its treatment as increasing the cost may be better. For instance, if in a shoe factory a workman makes ten pairs of boots of which two pairs are completely spoiled, there is no way by which the spoilage may be repaired, so that his product must be considered as eight pairs of boots. On the other hand, in the printing trade if a type-setter produces 10,000 ems containing twenty per cent of errors, his product is not 8,000 ems but 10,000, since workmen (proofreaders and hand compositors) are especially employed to make the type-setter's work perfect. In the former case the spoilage would reduce the product; in the latter case it would increase the cost.

IV.

A Typical Factory: Hour Rate and Piece Rate: Non-repairable Spoilage Charged to Profit and Loss.

Let us assume a simple glove factory in which a pair of gloves cut and sewed has a factory value of forty cents; twenty-five cents due to cutting and raw material, fit-

teen cents due to sewing. The normal week we shall take as fifty hours and the normal (or standard) product five hundred pairs, with a wage of three cents per pair or thirty cents per hour. The overhead charge is one dollar per hour. For the standard product due to sewing we thus have

500 pairs (@ $ .15. = $75, the factory value.
Costs:

50 hours (@ $1.30 = $65.00
10% factory gain = 6.50 [3]
Total cost = 71.50

Therefore, the

gain = $75. — $71.50 = $3.50

and the

$$\text{Standard rate of gain} = \frac{3.50}{71.50} = 4.9\%$$

Also, fifteen cents per pair is $1.50 per ten pairs, or a selling price (or factory value due to sewing alone) of $1.50 per normal hour.

Consider a workman who does a hours work in fifty hours, works b hours, spoils c dollars repairable and m dollars non-repairable. For the product we have b working hours

$$= \frac{ab}{50} \text{ normal hours, (@ \$1.50 per hour or}$$

$$\text{factory value} = 1.5 \times \frac{a}{50} \times b$$

Costs:

b hours (@ $1.30 = 1.3 b dollars
50—b hours (@ 1. = 50—b dollars
spoilage = c dollars
total = 50 + .3 b + c dollars
10% factory gain = 5 + .03 b + .1 c dollars
total cost = 55 + .33 b + 1.1 c dollars

The difference between factory value and cost gives the

$$\text{gain} = 1.5 \cdot \frac{a}{50} \cdot b - 55 - .33b - 1.1c$$

But non-repairable spoilage reduces this, and the

$$\text{actual gain} = 1.5 \times \frac{a}{50} \times b - (55 + .33b + 1.1c) - m$$

Multiplying the total cost by the standard rate of gain we obtain the

Expectant gain = .049 (55 + .33 b + 1.1 c)

Whence, by the definition of efficiency

$$E = \frac{1.5 \times \frac{a}{50} \times b - (55 + .33b + 1.1c) - m}{.049\,(55 + .33b + 1.1c}$$

Consider a workman, X, who works forty hours, is idle ten hours, and produces 450 pairs of gloves of which twenty are spoiled but repairable by one hour (i. e. one and one-half cents per pair) and five are non-repairable. We have

Workman X

$$a = 56\tfrac{1}{4}, \frac{a}{50} = \frac{450}{400} = \frac{9}{8}, b = 40$$

c = 1 hour (@ $1.30 = 1.3, and
5 pairs @ $ .25 anterior value = $1.25
5 pairs cost to sew, 4-9 hrs. @ $1.30 = $ .58
non-repairable spoilage, m = $1.83

Whence

$$E = \frac{1.5 \times \frac{9}{8} \times 40 - (55 + 13.2 + 1.43) - 1.83}{.049\,(55 + 13.2 + 1.43)} = 11\%$$

If we analyze the case of workman X on a piece rate basis we have

Factory value = 445 pairs (@ $ .15 = $66.75
Costs:

450 pairs (@ $ .03 = $13.50
20 pairs (@ .15 = .30
51 hours (@ 1.00 = 51.00
Total = $64.80

[3] The addition of the 10 per cent. to the costs is convenient, but in no sense essential to the theory. As will be pointed out later, the inclusion simply makes E equal 0 per cent, the lowest efficiency which produces the required 10 per cent. factory gain. Its non-conclusion makes a slightly higher value of E hte dividing line.

10% factory gain = 6.48
Total cost = 71.28
Actual gain = $66.75 — $71.28 = — $4.53
Expectant gain = $71.28 × 4.9% = $3.49

$$E = \frac{4.53}{3.49} = 130\%$$

An apparent contradiction only, since the loss on this man's work is greater when he receives the greater wage.

Summary:

	1. Piece-rate	2. Hour-rate	Ratio 1 to 2
E; per cent	—130	—116	1.12
Wage; dollars	13.50	12	1.12

If we put m = o, that is, agree to charge to profit and loss any non-repairable spoilage[1] the above formula for E becomes

$$E = \frac{1.5 \times \frac{a}{50} \times b - (55 + .33\,b + 1.1\,c)}{.049\,(55 + .33\,b + 1.1\,c)} \qquad (I)$$

which may also be written

$$E = \frac{1.5 \times \frac{a}{50} \times b}{.049\,(55 + .33\,b + 1.1\,c)} - \frac{1}{.049}$$

or

$$E = \frac{30.6 \times \frac{a}{50} \times b}{55 + .33\,b + 1.1c} - 20.4 \qquad (II)$$

Computing the efficiency of workman X on this basis we find

$$E = 62\%$$

For purposes of comparison consider another workman, Y, who works 50 hours and sews 600 pairs, of which 5 are damaged, but repairable by one-half hour's work, that is, at the rate of three cents per hour.

[1] Such spoilage would probably be accidental and infrequent, and, in the opinion of the writer, should not be charged to the workman. If it became habitual the workman would be discharged.

Workman Y. (using formula I or II.)

$$a = 60.\frac{a}{50} - \frac{6}{5},\ b = 50,\ c = .65$$

$$E = \frac{1.5 \times \frac{6}{5} \times 50 - (55 + 16.5 + .715}{.049\,(55 + 16.5 + .715)} = 503\%$$

V.

Varying the Standard Rate of Gain.

Let us next consider the effect of increasing the standard rate of gain. Suppose the increase in value per pair of gloves due to sewing to be thirty cents instead of fifteen cents. Then

500 pairs @ $.30 = $150, the factory value.
Costs, as before, (see section IV) are $71.50
Gain = $150 — $71.50 = $78.50

$$\text{Standard rate of gain} = \frac{78.50}{71.50} = 109.8 = \text{say, } 110\%$$

Also thirty cents per pair is $3 per ten pairs, or per normal hour, as factory value.

Costs (as before).
b hours @ $1.30 = 1.3 b dollars
50 — b hours @ $1 = 50 — b dollars
Spoilage = c dollars
total = 50 + .3 b + c dollars
add 10% = 5 + .03 b + .1 c dollars
total cost = 55 + .33 b + 1.1 c dollars
Factory value

$$= \frac{a\,b}{50} \text{ normal hours } (@\ \$3 = 3 \times \frac{a}{50} \times b$$

Actual gain $= 3 \times \frac{a}{50} \times b - (55 + .33\,b + 1.1\,c)$
Expectant gain = 1.1 (55 + .33 b + 1.1 c)
and

$$E = \frac{3 \times \frac{a}{50} \times b - (55 + .33\,b + 1.1\,c)}{1.1\,(55 + .33\,b + 1.1\,c)} \qquad (III)$$

or

$$E = \frac{2.7 \times \frac{a}{50} \times b}{55 + .33\,b + 1.1\,c} - .91 \qquad (IV)$$

Using III or IV we find for

Workman X. E = 83%
Workman Y. E = 135%

If we analyze these cases independently of the formula we have

Workman X

450 pairs @ $ .30 = $135.00

Costs:

40 hours @ $1.30	=	$52.00
10 hours @ 1.00	=	10.00
Spoilage	=	1.30
Total	=	63.30
add 10%	=	6.33 gives $69.63

Actual gain = 65.37

Expectant gain = 110% of $69.63 = $76.59

$$E = \frac{65.37}{76.59} = 85\%$$

Workman Y

600 pairs @ $ .30 = $180

Costs:

50 hours @ $1.30	=	$65.00
Spoilage	=	.65
Total	=	65.65
add 10%		6.57 gives $72.22

Actual gain $107.78

Expectant gain = 110% of $72.22 = $79.44

$$E = \frac{107.78}{79.44} = 136\%$$

VI.

Efficiency and Bonus

Let us return to the formula (I or II) of section IV; that is,

$$E = \frac{1.5 \times \frac{a}{50} \times b \quad (55 + .33\,b + 1.1c)}{.049\,(55 + .33\,b + 1.1\,c)}$$

Since the 10 per cent factory gain has been included in the costs the numerator of E is really the *surplus* gain; that is, gain over and above the required 10 per cent. Any bonus to the workman must be paid out of this surplus gain. But *the surplus gain is not constant for a given efficiency.* This may be shown as follows: Calling the total cost C and the surplus gain S we have, by the data of section IV,

$$S = 1.5 \times \frac{a}{50} \times b - C$$

which being substituted in the formula for E given above gives

$$E = \frac{S}{.049\,C} \quad \text{or} \quad S = .049\,C\,E$$

That is, the surplus gain (S) at efficiency E is equal to the standard rate of gain times the cost (C), times the efficiency (E). But for a given value of E the cost is not constant, and, therefore, the surplus gain is not constant.

On the other hand *the cost per normal hour and the surplus gain per normal hour are constant for a given efficiency.* To prove this the formula for E (II) may be written

$$E = \frac{30.6 \times \frac{a}{50} \times b}{C} - 20.4$$

whence

$$C = \frac{30.6 \times \frac{a}{50} \times b}{E + 20.4} = \frac{30.6 \times N}{E + 20.4}$$

where $N = \frac{a}{50} \times b$ = the normal hours

From the last formula it is obvious that the

$$\text{Cost per normal hour} = \frac{C}{N} = \frac{30.6}{E + 20.4} \quad (V)$$

is constant for a given value of E.

Also we may write

$$S = 1.5 \times \frac{a}{50} \times b - C = 1.5 \times N - C$$

whence

$$\frac{S}{N} = 1.5 - \frac{C}{N}$$

or

$$\frac{S}{N} = 1.5 - \frac{30.6}{E + 20.4} \quad (VI)$$

and the surplus gain per normal hour $\left(\frac{S}{N}\right)$ is constant for a given value of E.

Giving E successive values we compute the values of $\frac{S}{N}$ as shown in table III, column 2. It may be seen that the surplus gain per normal hour approaches the limit \$1.50 at which value E is infinite and the workman

TABLE III.

Efficiency, per cent. E	Surplus gain per normal hour, $\frac{S}{N}$ dollars. 4.9% rate	10% rate
100	.07	1.59
90	.06	1.51
80	.06	1.42
50	.04	1.09
10	.01	—.33
0	0	0
—10	—.01	.33
50	—.04	-3.59
X 62	—.05	
Y 50.3	.30	
∞	1.50	3.00
2040	∞	
91		∞
X23		1.45
Y135		1.81

perfect—and impossible. The value of E cannot go below —20.4, or —2040%, at which value $\frac{S}{N} = \infty$.

On the basis of the higher standard rate of gain (10% instead of 4.9%) the following formulae (VII and VIII) are computed in the same manner as formulae V and VI.

$$\frac{C}{N} = \frac{2.7}{E+.91} \quad \text{(VII)} \qquad \frac{S}{N} = 3 - \frac{2.7}{E+.91} \quad \text{(VIII)}$$

The third column of table III is computed by means of formula VIII.

If we analyze the case of workman X (basis 4.9% standard rate of gain) we have

forty hours = $40 \times \frac{9}{8}$ = 45 n'l hrs. (@ \$1.50 = \$67.50 factory value.

Costs:

40 hrs. (@ \$1.30	= \$52	Factory value = \$67.50
10 " (@ 1.00	= 10	
Spoilage	= 1.30	
Total	= 63.30	
add 10%	= 6.33	gives Cost = 69.63
	Loss	\$2.13

and $\frac{\$2.13}{45}$ – \$.05 loss per normal hour

Table IV shows the possible bonus, under each standard, of the two workmen, X and Y, and of two workmen with the following data.

A. $\frac{a}{50} = \frac{6}{5}$, b = 42, c = 0

B. $\frac{a}{50} = \frac{6}{5}$, b = 50, c = 9.52

VII.

Adjusting Wages or Docking: Conclusion

If, under the 4.9% standard, we suppose that workman X is "docked" the amount he loses, we have for his wage \$12 — \$2.25 = \$9.75. So that the costs are

Wages	\$9.75	Factory value	
Overhead	50.00	as before =	\$67.50
Spoilage	1.30		
Total	61.05		
add 10%	6.11	give total cost =	\$67.16

Actual gain = .34

Expectant gain = \$67.16 × 4.9% = \$3.29

and

$$E = \frac{.34}{3.29} \quad 10\%$$

Thus at this wage X is a profitable workman. His efficiency does not become zero, because, his costs having been reduced, the expectant gain is also reduced.

The question suggests itself how much must X be docked, or what wage can he be paid, to make him produce exactly the required 10 per cent factory gain?

Suppose a workman's wage is x dollars per hour. We thus have, using the other data as before,

b hours (@ \$x	= bx dollars
50 hours (@ \$1	= 50 dollars
Spoilage	= c dollars
Total	= 50 + b x + c dollars

add 10%, $5 + \frac{b x}{10} + \frac{c}{10}$ dollars

Total cost $= 55 + 1.1\,b\,x + 1.1\,c$ dollars

and the

Actual gain $1.5 \cdot \frac{a}{50} \cdot b - (55 + 1.1\,b\,x + 1.1\,c)$

Expectant gain $.049\,(55 + 1.1\,b\,x + 1.1\,c)$

$$E = \frac{1.5 \times \frac{a}{50} \times b - (55 + 1.1\,b\,x + 1.1\,c)}{.049\,(55 + 1.1\,b\,x + 1.1\,c)}$$

This formula enables us to determine what wage per hour (x) can be paid to a workman working b hours at a speed-efficiency $\frac{a}{50}$ and having c dollars of repairable spoilage, in order that his efficiency may be zero; that is, that he may produce the minimum required 10% factory gain.

Applying the data of workman X in this formula we have

$\frac{a}{50} = \frac{9}{8}$, $b = 40$, $C = 1.3$ and $E = 0$.

Therefore we have

$$0 = \frac{1.5 \cdot \frac{9}{8} \cdot 40 - (55 + 44\,x + 1.43)}{.049\,(55 + 44\,x + 1.43)}$$

whence $x = 25$ cents per hour.

Thus if X be docked $2, or if his weekly wage be $10 instead of $12, he will produce the required 10 per cent factory gain.

Many other interesting questions may be answered by the analysis of the formulae which have been derived, but space will permit us to consider only one more; namely, the effect on efficiencies of a general decrease in the wage rate. It may be remarked (see the discussion of section IV) that reducing the wage increases the actual gain, decreases the cost and the expectant gain, and, therefore, increases the efficiency. This is, of course, on the hypothesis that the factory selling price or factory value remains unchanged by the lowering the wages. For example if, in the discussion of section IV, the wage be reduced to ten cents per hour, the other data remaining unchanged, the formula for efficiencies becomes

$$E = \frac{1.5 \times \frac{a}{50} \times b - (55 + .11\,b + 1.1c)}{.049\,(55 + .11\,b + 1.1c}$$

For workman X we have (note that now $c = 1.1$) $E = 232\%$ as against -62% at a wage of thirty cents per hour.

TABLE IV.

Workman	Standard 120 per cent: E per cent	Supplies each per 1 hour	No. of units	Possible bonus dollars	E per cent	Standard 110 per cent: supplies each per hour	No. of units	Possible per cent gain	Wage per hour
X	62	.05	45	-2.25	83	1.45	45	65.25	12.00
Y	503	.30	60	18.00	135	1.81	60	108.60	15.00
A	200	.134	50.4	6.74	109	1.63	50.4	82.34	12.60
B	200	.134	60	8.03	109	1.63	60.	98.03	15.00

Summary:

	E	Wage	Possible bonus	Wage per week
Wage rate 30c	—62	12	—.05	—2.25	9.75
Wage rate 10c	232	4	.15	6.75	10.75

Note that, as we have shown, workman X produces the 10 per cent factory gain at a wage of $10 per week, the spoilage, c, being charged at the thirty cent rate. At the new ten cent rate, c being charged at ten cents per hour wage, he can be paid a wage of $10.75. Thus a lowering of

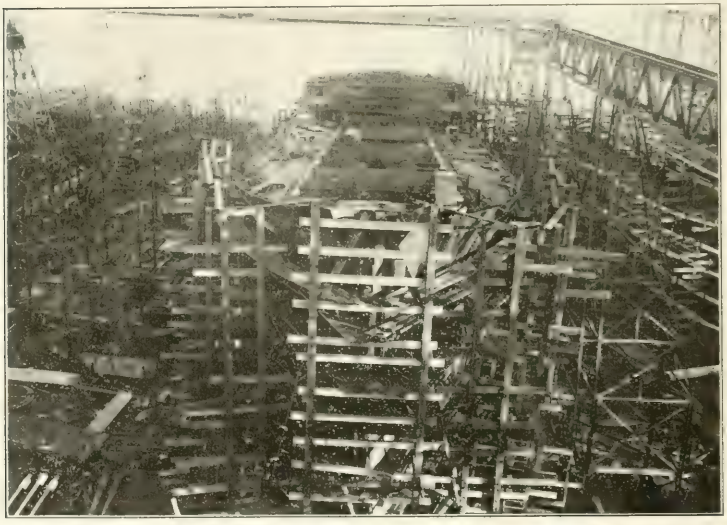
wages is offset by an increase of the per cent efficiency and bonus.

In conclusion the writer would point out that efficiencies, required factory gain, and standard rate of gain have no direct connection with the *profits* of the factory. Every workman of the hypothetical glove factory mentioned in the foregoing discussion may have an efficiency of zero or better, so that at least the required factory gain of ten per cent at the standard rate of gain is produced. And yet the conditions of the glove trade may compel the factory to sell its product at such a price that the gain is destroyed either in whole or in part. On the other hand, trade conditions may enable the factory to sell at such a price as materially to increase its normal profit. In either case if the conditions were long continued or permanent they would necessarily lead to a readjustment of required gain, wages, and expenses.

Finally it may be remarked that before practical use can be made of the writer's, or any other, scientific definition of efficiency, the determination and allocation of overhead and other expense in a factory must be made with much greater accuracy and precision than is at present generally the custom.

The Julia Luckenbach

The Julia Luckenbach, launched Dec. 23, 1916, sponsor, Miss Andrea Fenwick, is the second of a fleet of five large oil-burning freighters now under construction by the Fore River Shipbuilding Corporation for the Luckenbach Line of New York to engage in the general carrying trade. The Edward Luckenbach, the first vessel built under the contract, left the Fore River yards three weeks ago having fulfilled every requirement in her trials.



THE JULIA LUCKENBACH IN PROCESS OF CONSTRUCTION

The Julia Luckenbach, like the other vessels of the fleet, was constructed to special designs for the Luckenbach Steamship Company for its coast to coast and overseas trade. Her length is 456 feet over all and she has a dead weight carrying capacity of 10,000 tons. In the adoption of the modified cruiser stern, the novel arrangement of bridge and deck-house bulwarks, one large smoke-stack amidships, she is a handsome vessel of distinctive appearance. Her wide spaced frames are specially designed for the economical carriage and rapid handling of general freight.

The vessel is driven by a single Curtis turbine, with high and low speed reduction gears designed to deliver 4,000 H.P. at 90 revolutions, the turbine being so arranged that the ahead and reverse turbines are carried on one shaft and contained in one case. Steam is furnished by three boilers of the Scotch marine type, the fuel oil being carried in the double bottom compartments and in the forward and after peak tanks.

An Apology for Extreme Diligence

By C. Collins Bray, M. I. T., '20

Editor's Note: Last month we printed an article entitled Personal Efficiency, by a member of the class of '20. In direct accordance with our plan of giving space to the undergraduates wherein they may express their personal opinions on any subject which may enter their minds, we are this month printing another article by a member of the class of '20. We believe that Mr. Bray's article is the best of those of this style which came to our attention this month in both style and text.

AMONG the types of men that stand out from among the average mass of humanity are those who by nature are inspired with a feeling that they must be a little greater than their fellow beings and that, in consequence, it is their duty to do greater deeds. They feel that they must beat out, financially or otherwise, the common people in the course of life. It is not a conceited feeling at all. It is a conviction that has ever been with them. They wish to succeed to a greater extent than the average man, and usually nothing stands in their way. These men are usually very practical, energetic, sometimes hard-hearted, and often carry a spirit of leadership about with them. They will see a goal sometime or other, and then they make a sudden break for it, though it may seem foolishly impossible to the common people. And then it is that the contented, easy-going, good fellows, who are taking their leisure more or less along the rocky road of life, watch the over-diligent efforts of the ambitious one and cry out sympathetically, "Come, poor fellow, take thine ease, join us, live contentedly, and enjoy the good comradeship of your fellowmen." But the over-zealous man hears not and races madly on. Perhaps he is justly complained of but somehow there is an apology for his actions.

At least, the over-zealous man is showing those around him how to work. He is giving a free lesson in the art of accomplishing things. If he is not giving an example of the right way to live life, he is certainly showing many a one the correct way in which to go for a thing that one sees and wants. Granted that he is sacrificing comradeship among men, he does command respect at times for his being different. He shows us what a live spirit, a desire to act and stir up something rather than wish to drift along contentedly with the stream of average men, will do. Be he right or wrong, the over-diligent man is emphasizing the difference between industriousness and idleness and is causing someone to ponder deeper on the problem of living life most expediently.

The over-diligent man is found in all branches of life. Among students the grind is inevitable, and perhaps it is well that it is so. It is true that this person does seem to wish to give up good fellowship with his mates in order to "ply more diligently his book." He is often abused or pitied. He will be accosted, "Come, dear fellow, what dost thou mean by thy craze for learning? Come, join with us, and you will learn to live life as it should be lived." But the grind turns his back and says, "Nay, I wouldst follow the appointed lesson more diligently, in the hopes that I may find something, still undiscovered, that will benefit myself and thyself." And how often is this the case. The exceedingly busy fellow may come into class with a weary look in his face, but he may have hit uopn some im-

portant point that would otherwise have been passed over. Then, too, the grind often elevates the standard of the class. The idleness of the idler will be emphasized and he learns his lesson. The average fellows themselves are a little afraid at times that the grind will get out of sight of them in the race for learning and they perhaps "ply" a little more diligently. And though they don't form true friendship with the grind, they have a surprisingly firm confidence in his word and work. So the grind, be he right or wrong, often commands the confidence of his mates and oftimes actually gains their respect if he unearths something in his tedious labors that benefits everyone.

The grind's place in student life is an analogy to the man who becomes crazy for business or some other undertaking. We often see this man with all his bustle, rustle, and surplus energy. We often complain of him, but we must remember that he is human. It should be borne in mind that a man often inherits qualities from his forefathers that stamp him as being different from the average man. Or perhaps he has become imbued with fixed ideas in his youth. Then, too, many a man undergoes the bitter experience that Silas Marner underwent. He loses all faith in God's people and then, instead of bewailing the fact, becoming stale, and rotting away, he doffs his coat, rolls up his sleeves and tugs away altogether too diligently at any tedious task. It seems well for a man to be able to get mad at the world and its people some time or other. Then there is action, and sometimes fortune directs the actions of the man with too much energy so that he will benefit the community. We cannot blame a man if he is born with a spirit of being extremely busy, and we should not ask him to kill his spirit and live as we do.

If a man lives as an idle hermit we can only pity and reprove him, but if a man lives as a very industrious hermit we must excuse him for not coming out and being friends. Much is owed to the person who sacrifices his chance to come out and play and who, instead, shuts himself up and sticks to some hobby that to us is work. When he comes out of his hiding place perhaps he can tell us something. The extreme efforts and sacrifices of an Edison were not for nothing. We should be glad that there exist men whose play seems to be work for us. For they often give us information about their play (our work) that helps us immensely. Extreme activity in any field will bring out new ideas and facts that usually prove to be very valuable.

Then let's apologize to the man who acts as an ant for the hard feeling that we're likely to have toward him. He is human; not superhuman. Let us not break up the spirit which is born in a man, but let it have its run, good or bad. Let a man have a hobby. If the hobby is to be extremely busy with some business or undertaking, let's respect the man who has the courage of his convictions and who can depart from the average man's path of life and make new discoveries.

The Hygiene of Swimming Pools

By Arthur W. Weysse, A.M., M.D., Ph. D.

Professor in Boston University. Formerly Instructor in Massachusetts Institute of Technology.

Editor's Note. Any of you may, in the course of your careers be called upon to construct or maintain a swimming pool. Aside from an asthetic consideration the two main essentials in the design and care of a swimming pool are, first, that it be so constructed as to hold water, and second, that it be hygienic. We take it for granted that you can handle the first mentioned, but how much do you know about its sanitation?

THE swimming pool has come to be recognized as a necessary appointment of every well equipped gymnasium, whether controlled by a college, school, Y. M. C. A., city, town, or private individuals, so that the question as to whether it may become a menace to health is a vital one. The danger from using the swimming pool when the body is overheated or exhausted is the same as from bathing in any other cool body of water under similar conditions and so is not inherent to the swimming pool, but the use of a limited enclosed body of water by a considerable number of individuals presents several very definite problems in sanitation, which here as elsewhere is largely a matter of applied knowledge and common sense.

The problem is fundamentally one of cleanliness, and even the reading public is gradually coming to recognize that dirt is dangerous chiefly through the germs that it contains, whether these are plant germs, such as bacteria and certain moulds, or animal germs, which for the most part belong to the more lowly organized forms of life. Many germs can remain alive and active for a considerable period of time, several hours and sometimes days, or even longer in the presence of moisture, hence our legislation against the common drinking cup and public towel, and though many germs are harmless, many produce disease. There are always germs in a swimming pool that is being used. Two first class pools that were examined a few years ago contained from 75,000 to 600,000 bacteria per cubic centimeter after a single day's use, so we may well inquire whether diseases have actually been traced to this source.

A considerable number of investigators have studied this problem, and we seem justified in concluding at present that the chief diseases that may be acquired from swimming pools are gastro-intestinal, venereal and respiratory. Every person using a pool gets water in his mouth and nostrils, and whether he swallows it or not, disease germs may thus gain entrance to the body, and inflammation of the stomach and intestines, various forms of diarrhoea and even typhoid fever may result. The chief danger of typhoid comes from the typhoid carrier, an individual who has had the disease and has entirely recovered, but still harbors the typhoid bacilli in his body; they can no longer harm him,—he has acquired immunity to their poisons,—but they may be actively virulent if they enter the body of one who is not thus immune. However, as far as definite cases go, the danger of the transmission of typhoid in this way is not very great, but it should, of course, be guarded against by locating typhoid carriers and excluding them from swimming pools.

Further, the danger from venereal diseases is not, I believe, great. The germs of the two most serious venereal diseases, gonorrhea

and syphilis, do not flourish outside the body, though there are plenty of cases where they have been transmitted other than in the usual way. About 25 years ago a German writer reported 234 cases of gonorrhea among women who were exposed to it in a single pool,—but authentic cases are rare. These diseases are so serious in their consequences, however, despite some popular opinions to the contrary, that no person suffering from them should be allowed to use a swimming pool.

The greatest menace from the point of disease is undoubtedly in respiratory affections. "Colds in the head" are so common with us in this climate that we are in danger of forgetting how serious they may be in their sequelae. "Colds" are more frequently due to germs than many people believe, and there have been mild epidemics of "colds" and sore throats from the use of swimming pools. A "cold in the head" may result in the serious infection of the frontal sinuses or the antrum, and cases of infection of the middle ear, with mastoiditis and its serious consequences, even death, have been attributed to swimming pools. It is clear, then, that persons with colds, sore throats, tonsilitis or coughs should not be allowed to use swimming pools.

What precautions, then, should we take to protect the health of bathers? First of all, no one suffering from any of the diseases I have mentioned or from any transmissible skin disease should be allowed to use a swimming pool. There should be some one in authority to decide who may and who may not have that privilege, and any case that is doubtful should be held up until a physician has made an examination. In the second place, every bather must take a thorough scrubbing with warm water and soap, paying special attention to the hairy parts of the body, before entering the tank. An ideal arrangement is to have the only entrances to the pool room through the shower-bath rooms, so that the floor about the tank may not become contaminated. Concerning costume, I believe that supplied by nature is best, namely, none at all. If a costume seems desirable, something in the nature of a jock-strap that has been sterilized by boiling is best. In pools where both sexes are allowed to bathe at the same time more clothing, of course, becomes necessary, but in general the more clothing worn in a swimming pool the more dangerous it becomes. Further, the water should be sterilized daily. Practical experience seems to indicate that it is best to use the same water for weeks, passing it continuously through a suitable filter and sterilizing it by chemical means each day after all the bathers are out. No chemical seems to be more satisfactory than calcium hypochlorite, and a good working rule is that for every 60,000 to 70,000 gallons of water, one pound per day is sufficient. A very simple and effective method is to place the chemical in a perforated can and drag it over the surface of the pool until it has gone into solution. As a final precaution bacteriological tests should be made from time to time.

In conclusion and by way of summary,—in order to keep a swimming pool hygienic it must be kept free from contamination as far as possible, by careful physical examination of those who use it, by thorough scrubbing of the whole body with warm water and soap and by forbidding expectoration in the water and supplying suitable cuspidors about the tank, while the water should be filtered continuously, sterilized daily and tested bacteriologically at suitable intervals.

Toledo's New High Pressure Pumping Station

By W. J. Sherman, Consulting Engineer

THE practically total destruction by fire of the property within the congested districts of Boston, Chicago, San Francisco and Baltimore because of inadequate fire protection, together with the recognized advantages of lower insurance premiums has resulted in the establishment of special fire service systems separate and distinct from the domestic service systems for numerous American cities, including New York, Philadelphia, Baltimore, Cleveland, Winnipeg, Toledo and Boston.

It is rather difficult to say at this time who first conceived the high pressure system for Toledo's congested district, but in 1905, when Robt. H. Finch was Mayor and I. E. Kinsley, C. F. M. Niles, John Daiebr and D. C. Donovan comprised the Board of Public Safety, with Thos. R. Cook Superintendent of Water Works and William Mayo Chief of the Fire Department, the movement seems first to have gotten under way.

In April, 1905, Mr. K. L. Walling, Superintendent of the Toledo branch of the Ohio Inspection Bureau, issued a special report on the conditions in the congested district, in which we find the following reference to the need of a high pressure system, viz:

"An auxiliary high pressure system of piping and hydrants to be fed by a fire tug would be of a most valuable addition for the protection of the down town district. The purchase of a fire tug and the installation of an auxiliary hydrant system is recommended for the protection of the business district and the river front property."

Again, in December, 1908, we find reference to the subject in a report by the National Board of Fire Underwriters in this language:

"The Board of Public Safety, through the Chief of the Fire Department (Mayo) is recommending a high pressure fire system. . . . . It is proposed to furnish the supply for this system by a 10,000 gallon (per minute) fire boat, the purchase of which is recommended."

Meanwhile, the late Franklin S. Macomber, member of the succeeding Board of Public Safety, representing the business interests of the city became very much interested in the general proposition and was very active in the movement. In the summer of 1908 Mr. Macomber was favored by Chief Croker, of the New York Fire Department, with a demonstration of the fire fighting facilities of the department, during which he mobilized all the fire tugs in the harbor.

While the original project contemplated the use of fire boats, as noted, yet a council committee consisting of Wm. Mayo, Chief of Fire Department; James M. Wisler, Supt. of Water Works; and Councilman C. H. Webster recommended a high pressure pumping station instead of a fire tug as at first planned.

The committee's recommendations were adopted by Council and an ordinance appropriating $41,570 for the city's portion of the mains was passed Nov. 21, 1910, and on March 23, 1914, Council appropriated $20,000 for the purchase of the site for the pumping station, and May 25, 1914, $180,000 for the station itself.

Under authority from Council there were

laid 22,500 feet of 10 in., 12 in. and 16 in. Class "G" extra heavy cast iron pipe in the principal business district bounded on the north by Cherry Street from the Maumee River to Superior Street, thence south to Jackson Avenue, thence west to Michigan Street, thence south to Monroe, east to Ontario, south to Washington and east to St. Clair, north to Monroe and east to the Maumee River, embracing an area of 160 acres and protecting approximately 200 acres.

In October, 1914, the writer was engaged by the city to prepare plans and specifications for the pumping station and its equipment, and about May 1st, 1915, contracts were awarded as follows, viz:

Superstructure, The A. Bentley & Sons Co.

Equipment, The Arrow Engineering Co.

The total cost of the Fire Service Pumping Station will be well within the appropriation of $180,000, notwithstanding the fact that a third story has been provided for the structure since the appropriation was made. This was done for the double purpose of improving the appearance architecturally and also of providing 5800 square feet of floor space for some one of the city departments.

Equipment

The station is intended to be a model one in every respect.

The initial installation calls for four (4) motor driven, five (5) stage centrifugal pumps, each capable of delivering 2,000 gallons per minute against a pressure of 300 pounds per square inch at a speed of approximately 1,500 r. p. m.

There are blank spaces for two (2) additional pumps. The supply will come direct from the river and the distribution system is entirely separate and distinct from that which carries the filtered water.

The motors for driving the pumps are of the alternating current, slip ring induction type, three (3) phase current at 25 cycles and 4,000 volts will be supplied for the operation of these motors. The normal rating of each motor is 550 horse power. Current will be furnished by The Toledo Railways & Light Co. for both A. C. and D. C. circuits, though an emergency direct current motor generator set has been installed.

Meters have been placed in each of the two (2) sixteen (16) inch discharge lines, leaving the station with recording rate of flow and total flow gauges.

All important valves will be motor operated.

EXTERIOR

A twelve (12) panel switchboard of Blue Vermont Marble has been provided.

The oil switches for the control of the high tension current have been placed in the pipe gallery.

Basement drainage is taken care of by means of a vertical sump pump and motor, while for emergency use the larger pumps can take suction direct from the sump.

The High Pressure System will be kept full of water at all times ready for instant use.

The operator at the Fire Service Pumping Station will be kept informed of the progress of fires and the requirements of the

Fire Department by telephone and by the Fire Alarm Telegraph System.

Insurance

The Ohio Inspection Bureau classifies municipalities of the state according to their fire fighting facilities.

There are ten (10) classes, viz:

Nos. 1, 1 1-2, 2, 2 1-2, 3, 3 1-2, 4, 4 1-2, 5, 6.

Cleveland is the only city in the first class, Cincinnati the only one in Class 1 1-2, Columbus the only one in Class 2, and Toledo the only one in Class 2 1-2, while Class 3 comprises Lima, Hamilton, Dayton and Youngstown.

During a general rerating of this city in 1914 the residential districts were transferred from Class 2 1-2 to Class 1, and within three (3) months after the completion and satisfactory testing of the system it is expected that the property in the congested district is to be transferred from Class 2 1-2 to Class 2.

Tests

The equipment and pipe lines of the High Pressure system have been undergoing satisfactory tests under operating conditions for several weeks past preparatory to transferring the plant from the contractors to the permanent operating force to be maintained there by the City.

The Future

It is proper to call attention to the fact that the pumping capacity of the station, viz., 8,000 gallons per minute from the four pump units already installed with 4,000 gallons per minute additional from the two (2) future pump units, foundations and piping for which are now ready, is sufficient to care for a much larger central territory than the 200 acres protected by the existing system of high pressure mains, and therefore the city should soon undertake the construction of additional mains designed primarily to reinforce the existing system and so located as to provide for territory now protected by high pressure.

AT WORK

Recommended Recreational Reading

By Howard G. Mann, M. I. T., '17

Students of engineering have been criticised for choosing a profession which tends to remove them from normal and healthy relations with their kind. They have been accused of being educated in the narrow field of technical literature and of having no social instincts. The R. R. R. committee of T. C. A., which was formed last year, stands ready to refute all these statements. It has been the aim of this committee to make special efforts to stimulate students' reading and to direct it according to the special needs and recommendations submitted by alumni and professors. The books have been placed in the General Library until they can be removed to new quarters in the Walker Memorial, and their popularity has been remarkable.

The results show that there are many Technology students who do browse in the field of art and letters and that they realize there is no society so good, so varied, and so easy of access as that to be found in books. There is no doubt that many of our students are from hard-working homes and they appreciate the ability to compare the value of the things in life with the theoretic standards of literature. These men do not read because it is their hobby, or because this knowledge of books is to be used to make impressions in society; they feel it is necessary for complete living. We cannot know engineering if we do not also know certain good novels. An appreciation of books is an appreciation of life, and nothing less.

Students at Tech do not read merely for amusement or to take up hours of leisure. They read for a comprehension of other men's feelings and find sympathy and unexpected pleasure in the comprehension.

I take the liberty to quote from letters received from our alumni the following passages which accompanied their recommendations.

"A student at the Institute gets pretty well loaded with dry technical literature. There is little in modern writings brighter, wittier and more cheerful than the works of Ian Hay. The students may think the story elementary and they may possibly find it uninteresting, but the great cleverness in depicting character, and the real wit found in practically all of Ian Hay's writings make the plot almost immaterial and cannot help but prove a source of mental rest and recreation.

"In quite a different field, but still outside of anything really heavy or matter-of-fact, will be found 'The Other Side of the Lantern,' by Sir Frederick Treves. This book is a description of a trip around the world referring, however, particularly to India. Though prose, it is in thought and expression as truly poetical a work as I ever read. To be truly poetical, one must have a vivid imagination and, preferably, use the beautiful similes rather than the horrible. The Technology student is not much given to poetry, nor even to flowery prose descriptions. However, the ability to describe one's thoughts and plans to others, and put them in settings where they will be not only clear but attractive, are things for which the engineer and scientist should strive, nor can he make the greatest use of his technical and scientific attainments until, and unless, he has developed an imagination and the ability to clearly express himself. I know of no modern work which evidences a more fertile imagination, nor one in which the description is more varied and beautiful than 'The Other Side of the Lantern.' It is not a book that need be read through from

beginning to end. It may be read only in part, but everywhere, I feel sure, will be found evidence of what most Tech men lack,—poetic imagination."

In another letter, Mr. James P. Munroe has written the following outline of the books which he recommended: "Wm. C. Redfield's 'The New Industrial Day' should be read by every young man going into business or manufacturing. It emphasizes the importance of the man rather than the machine and summarizes the best thought on the proper relations of employer and employee.

"Lincoln, Master of Men," by A. Rothschild, is, I believe, the best biography of Lincoln ever published. It is a book that makes clear the fundamental importance of being able to deal with men and to handle them judiciously."

"Dr. Gulick's "Efficient Life" contains sound and sensible advice on the regulation of one's life so as to be of the most efficient service in the world."

"One of the best of the recent novels is 'The Bent Twig' by Canfield. It deals largely with the standards of a college town, and shows the lasting influence of home surroundings."

The following is a list of the books recommended during the past two months by those men who have been approached by the committee:—

Recent Arrivals—"England's Effort," "The Painted Scene," "Mr. Britling Sees It Through," "Hillsboro People," "The First Hundred Thousand." Recommended by Dean Burton, Prof. Pearson and Prof. Aydelotte.

Previously Received—"What Men Live By," "Problems of Living," "The Making of an American." Recommended by Dr. Mann of Trinity Church.

"Four Million," "Riddle of the Sands," "The Pentacost of Calamity," "Kipling's Verse." Recommended by Prof. Pearson.

"How To Study," "The Human Machine," "Through College on Nothing a Year." Recommended by Dean Burton.

"The New Industrial Day," "The Efficient Life," "The Bent Twig," "Lincoln, Master of Men." Recommended by James P. Munroe, '82, Sec'y of the Corporation.

"A Safety Match," "A Man's Man," "The Other Side of the Lantern." Recommended by A. F. Bemis '93.

"The Lady or the Tiger," "The Wrong Box," "Treasure Island," "In the Fog," "Two Years Before the Mast." Recommended by Registrar Humphreys.

"Richard Carvel," "Van Bibber and Others," "Gallagher and Other Stories," "Captain Eri," "Captain Warren's Wards." Recommended by Prof. Merrill, Sec'y of the Faculty.

These books form the nucleus of the Walker Memorial Library and are to be found now on a special shelf in the General Library.

Tennis at Technology

By Harold V. Kaler, M. I. T., '18

Do you play tennis? Of course, everyone plays the game. You may play it like Harry Coyne plays golf, but, even then, you have a general idea of what to do. Perhaps you have not played for several years! At the present time this seems to be the case of quite a number of fellows. Popular interest in tennis seems to become intense at intervals of six or seven years. This year seems to be the first of the seven years of high intensity of interest at Technology. Up until this year fellows took a very luke-warm interest in tennis. Last year the tennis team made a fairly good showing, winning five out of seven matches, but there was, however, no popular interest in the sport. This was shown by the large percentage of defaults from the tournaments. This year there seems to have been a great change. Out of forty-one entries to the fall tournaments there were only three defaults. This fact, together with the results of the census of tennis players recently taken, seems to show a remarkable revival of interest in tennis at Technology.

A brief history of tennis at the Institute runs about as follows. In 1911 tennis enthusiasm was at a very low ebb and little was done. In 1912 there was more enthusiasm in the fall tournament, and in the spring of 1913 there were a few team matches played, Tech winning about half of them. That spring, Tech was represented in the Intercollegiates. In the spring of 1914 the team won four out of five matches and scored points in the Inter-Collegiates. Two men went as far as the semifinals in the doubles. In the Spring of 1915 the team won three matches and tied one. Again two men went through to the finals in the Intercollegiates, thereby winning their straight T's. In singles one climbed to the semifinals. In the spring of 1916 the team won three matches and tied one, and came through in the Intercollegiates to the semifinals in both singles and doubles. Hence from 1911 Technology has gained second place in the number of points on the cup for which Bowdoin, Brown, Trinity, Tufts, Williams, Amherst and Wesleyan are competing.

At present there are at the Institute a number of good tennis players. The material for a team is the best that there has been for many years. Last fall in a match against Longwood second team, Tech made a good showing in the individual match scores.

Even though the match was lost the team made a very creditable showing.

The team will consist of six men and two substitutes. The substitutes may be challenged to play and in this way a man who wishes to make the team may be tried out.

There is exceptionally good material for tennis in the Freshman Class and it is very probable a Freshman Team will be started. A few matches are being arranged for such a team against the Freshman of other colleges.

Through the courtesy of the Longwood Tennis Club we are permitted to use their courts for the home matches of the team this spring.

The schedule of matches which has been arranged is as follows:

April 25	Harvard 2nd at Harvard.
April 28	Brown at Longwood.
May 2	Harvard 2nd at Harvard.
May 5	Holy Cross at Longwood.
May 9	Tufts at Longwood.
May 10	Harvard Freshman vs. Tech Freshman at Harvard.
May 12	Bowdoin at Longwood.
May 14-18	Intercollegiates at Longwood.
May 19	Williams at Williams.

May 23 Tufts at Tufts.
May 25 Trinity at Hartford.
May 26 Wesleyan at Middletown.
May 30 A. M. Holy Cross at Holy Cross.
P. M. Brown at Brown.

Technology at present stands second in the Intercollegiate, Amherst having a greater number of points. These matches are held in Boston on the Longwood courts and it is to be hoped that Tech will score more points in them this year.

Just now it seems very probable that we will have tennis courts at Technology. The proposed position of the courts is between Building 2 and the Walker Memorial as shown in the following sketch:

Many of the faculty play tennis and some are very much interested in obtaining courts at Technology. There seems to be no doubt that the courts will be used if they are constructed. Tech men will be found at Jarvis field, Cambridge, almost any day during the playing season. A general census has been taken and there seems to be a large number of students and members of the faculty who are willing to pay ten cents an hour for a court. It has been shown at Harvard, Yale and many other colleges that it is highly profitable, purely as a business proposition, to construct tennis courts and charge for them at this rate. At Harvard the tennis courts clear $300.00 per month so that courts at Technology should be a good financial investment for the Institute if they were used as much as it is expected.

This is the tennis situation as it looks at present. If we are able to obtain courts, and the undergraduates play the game and try out for the teams as we expect them to, the future of the sport at M. I. T. is an assured success.

Harold V. Kalen.

Exercises at Technology

By Lansing McVicar, M. I. T., '18

MOST of us come to Tech with a definite aim in view: namely, to become the best engineer, the best chemist, or the best architect, that we can make ourselves. Such an ambition is certainly laudable; there are few institutions of learning, be they schools, universities or colleges, which can boast of such persistent and determined effort on the part of their undergraduates. It is well, and we are justly proud of the fact that we are here to become engineers, not players at some game, that we come to work, not to play at work. Many of us, however, lose sight of the fact that to be a good engineer, you must first be a good man; to have an efficient brain, you must first have a healthy body. You can not successfully develop one part of your anatomy at the entire expense of all the rest. If you are to think clearly and consistently, day in and day out, you must have a healthy body to give backing to your brain. Likewise and more important, an unclean, half-sick body breeds an unhealthy, indecent mind. The two cooperate in morals, in work, in play, in everything. Examples are too numerous to quote; but take any executive man, and you will see that his success comes from his force, his force from his vitality—or personality, if you will—and both of them from the state of his body. Consider then that to be a good engineer you must first be a healthy, clean thinking citizen, after that know the trigonometry and mathematics.

This may seem axiomatic, yet it is a fact that out of the upper classes in the Institute not more than one hundred take any regular exercise. It would not be an exaggeration to say that about 1,400 men take practically no exercise at all. What is the result? It is, we must admit, that, as a whole, we are a pretty pale-faced, unhealthy looking bunch. At our particular time of life we are developing. Bodily exertion is essential for that development. Men who do not undergo this physical effort, do not know what it is to feel really well; they can not be at their maximum efficiency; a fact ably proved by the one hundred here at Tech who do exercise.

The reason for this lack of interest in so important a feature is obvious. There is very little chance for it. The gym is not yet completed; the opportunities for other sports are limited. To play hockey in the winter one must get up and practice at seven in the morning; to swim one must go at odd times to the Y. M. C. A.; to play baseball one must also arise considerably before breakfast. And so it goes. Is it worth while? No, it does not seem so; you feel very much disinclined to make the effort. But, on the other hand, if you do try it, and come back from a good sweat and cold shower feeling like a different man, it is another story.

Although all exercise is good, certain kinds are more adaptable to what the M. I. T. Bulletin terms the "rigorousness of curriculum." Track and wrestling are our major sports, for the simple reason that they form two of the most concentrated types of exercise. In particular may be pointed out the excellent record of the wrestling team, which, together with the many other Tech achievements, proves that whenever Institute men do go into games, they make good. This is equally true of the men who have done track work. The few men who have come out in years past have made very creditable performances, such as in the victory over Cornell in relay last March. Nor is there any reason why we should not do

well in this branch of athletics. Let me point out some of the more specific advantages of the Institute for track work,—not with the idea of bringing out some hidden champion, but solely with the purpose of showing a very easy and efficient way to get exercise at Tech. To begin with, it is no exaggeration to say that we have one of the very best coaches in the country, a man in a class with Mokley, Schrubb, or anyone you might name; we have, as well, one of the best tracks, together with a fair set of shower appliances. Not two hundred yards from class rooms is the field, and it is possible even to take your "work outs" in spare periods in the morning. None of the objections accruing from the supposed difficulties of time and inconvenience are present. No man can excuse himself on any ground that may, in former years, have prevented him from coming out. We have now the best of opportunities. Well, so much for our particular assets.

Now, let us consider the advantages of running itself. First, it is the most natural of exercises; and although perhaps lacking in the savor of a game that is played perhaps only occasionally, or at one season of the year, there is in it a manly quality which makes up for all other faults. It has no place for quitters, for if you quit in a race, not only do you know yourself that you have quit, but everyone else knows it too—and you are branded.

Best of all, running gets you mixing with other men, competing against them and with them, knowing them in other phases of life than in the class room. When a man is naked in a shower, down on a mat, or staggering to the finish of a hard run race, he is bound by none of the freak conventionalities of civilization that otherwise characterize him; he is himself. Then, too, there is the question of "getting a letter" —to my mind of least importance. Many men refuse to come out because they say they "have no chance." This is absurd, for a man who comes out and tries consistently does as much good both to the Institute and himself as the man who gets a "T," a "ATA," or what-not. The letter is only the sign. As a matter of fact, however, if you must confine your attention to letters, you will find that the insignia of Tech in Track or in anything else is quite as hard and as glorious a thing to win as that of the colleges which lay more emphasis on athletics.

In conclusion, let me say that you owe it to your own success to take exercise; that you owe it to the Institute to bear high her standard. It is never too late to come out for any line of sport. An unsurpassed opportunity is offered for track and cross country work in particular.

BRIDGE ENGINEERING

By J. A. L. Waddell

2 Vols. 2177 pp., New York 1916.
John Wiley & Sons.

Reviewed by Professor George F. Swain.

THE author of this work, unique of its kind in structural literature, has long been a prominent figure in the engineering world, in which he has done work of great value as a consulting bridge engineer, and also as the writer not only on technical subjects, but on educational and other non-technical topics as well. Returning from Japan in the early '80's, where for some years he had been professor of engineering at the Royal Technical School, after a short connection with the Phoenix Bridge Company he established himself as a consulting engineer in Kansas City. His business soon grew to large proportions, and he was able to do much to uphold the highest standards of the profession, and to do good work in calling attention to slipshod and inefficient methods, particularly in conection with the construction and letting of highway bridges. Dr. Waddell's work, however, covered a wide range, including almost every kind of structural work, and the experience which he has gathered is large, accurate and valuable. This experience is laid down in the work now presented to the public, which is an enlargement of a very much smaller work published some eighteen years ago, entitled "De Pontibus," which soon became well and favorably known among structural engineers.

The present work is not a text-book or a book on the theory of stresses; indeed, the ordinary theory of stresses usually treated in structural text-books, is entirely omitted. The present work begins where most elementary text-books leave off, and treats of certain more advanced theoretical subjects and of a large number of practical details and general considerations of great value. It does not even pretend to treat in detail the advanced theory of indeterminate structures. It leaves the student to get this from the usual text-books, of which there are so many excellent ones, but supplements such works by general considerations, theoretical or practical, which throw light upon the larger problems of design.

There are eighty chapters in the book, and within the limits of this review only a few of them can be even mentioned. Such general topics as the "Evolution of Bridge Engineering," "Aesthetics in Design," "True Economy in Design," "Office Practice," "Bridge Failures and Their Lessons," "Responsibility of the Bridge Engineer," "Ethics of Bridge Engineering," and other chapters indicate the wide range covered by the work. A novel chapter is that on "Expedients in Design and Construction," in which instances are given of the very important quality of "gumption" or fertility of resource, which every successful engineer must possess in greater or less degree.

The work treats in considerable detail of the materials of bridge construction, with a long chapter on alloy steels, a subject to which Dr. Waddell has given particular attention and for which he received in 1909 the Norman Medal of the American Society of Civil Engineers for his paper on "Nickel Steel for Bridges."

The loads to be allowed on various kinds of bridges, including the subjects of

impact, centrifugal force, the effect of vibration, etc., are thoroughly discussed. Secondary stresses and deflections form the subjects of separate chapters. There are also separate chapters on the designing of the various usual types of bridges, and also of cantilever bridges, arch bridges, suspension bridges, and the various types of movable bridges; also of elevated railroads. In these chapters, as throughout the book, the author aims to supplement the usual text-books rather than to cover the same ground. The chapter on arch bridges, for instance, does not present the complete theory of the elastic arch, but in thirty pages discusses the general considerations concerning the different types and their relative economy. The chapter on suspension bridges, likewise, leaves the student to pursue the theory in works like that of Professor Burr, and confines itself to a general discussion.

This work also discusses reinforced concrete bridges, giving formulae and tables for the computation of such structures. It also deals in a less complete manner with the subject of foundations, to which five chapters are devoted.

The above outline will perhaps indicate the large amount of ground covered by this excellent work, notwithstanding the fact that it begins where many of the ordinary text-books leave off. It is clear from the above that it is not a work for the beginner. To read this book intelligently, the reader should be familiar with the subject of strength of materials, and with the theory of stresses. Equipped with such information, he will find the present work a mine of information from which the riches to be obtained will depend only upon his own industry and capacity.

Dr. Waddell writes in no stiff, pedantic, academic fashion, but in an easy, conversational manner he gives the reader freely from the abundance of his professional experience. The work also represents a very large amount of research and investigation in the tabulation of data and the preparation of tables and diagrams in convenient form for use. It is safe to say that the work will be found indispensable in the library of every structural specialist who desires to keep abreast with the progress of his profession and to take advantage of rich stores of experience when offered for his assimilation.

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Engineering Journal

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All manuscripts submitted for publication in the TECHNOLOGY MONTHLY ENGINEERING JOURNAL should be accompanied by the writer's full name and address. Manuscripts not accepted for publication will be returned only if the author so requests. Photographs, drawings etc., will be returned to the contributor immediately after publication.

Forms close the 28th of the month immediately preceding date of publication. Material specially arranged for may be received up to the fifth day following.

EDITORIAL

WATCHFUL WORKING

DAILY the cry goes up all over the world for something to do. Thousands of men and women are looking for opportunities; for some situation to take advantage of and thereby profit and prosper. Yet to a great number the call is unanswered; they cry forth and are unheard.

To some failure is inevitable; such is fate. Yet the large remainder who fail owe that failure to lack of foresight. They look at today, and they forget tomorrow; they look at a thing, but not through it. To be successful one must prepare for the morrow. The byproducts of yesterday's life are factors in the life of today; they have been developed through foresight.

Chance lies before all in every day life. It may be disguised, it may be cloaked and concealed, but the man who succeeds pierces the disguise and views the inner possibilities. If we prepare for chance, we invite success. The successful president of industry has not run through the want-ad column of the daily newspaper looking for that work. He has invited success by entertaining opportunity and has climbed the ladder step by step. Waiting for opportunity does not mean waiting in a literal sense. Rather it means preparing so that when the chance does present itself, it may be seized. Let the task at hand be managed with all of the seriousness of one upon which the entire future is dependent.

TECHNOLOGY'S AERO CLUB

TECHNOLOGY has organized a new Aero Club. We believe that this is a highly expedient movement. If the aeronautical engineer is not claimed by military duties, he is bound to be claimed by industrial duties. In either case he will serve his country to advantage.

The importance of the air plane in modern warfare has produced a great demand for all of the modern types of air craft. There have consequently, under this forced condition, appeared those changes and developments which are fitting the aeroplane for more practical and efficient military and industrial service. At present the industrial field is being neglected because of the demands of war conditions, but with the close of the war there will undoubtedly appear new and genuine uses for the air plane in the industrial world.

Technology men are fortunate in having this organization which promises to better acquaint them with the field of the aeronautical engineer.

TENNIS AT TECHNOLOGY

THE tennis enthusiasts of Technology are making a creditable attempt to obtain courts located on or near the Institute grounds. In this issue, under the title of "Tennis at Technology" there is given a good and clear line of reasoning as to why Technology should have these courts. We believe that this movement should be recognized and receive the endorsement of every person who has the interest of Technology at heart.

ANNOUNCEMENT

WITH this issue THE TECHNOLOGY MONTHLY ENGINEERING JOURNAL has made a change of printers, and similarly a slight change in type and style. The Board of Directors of the publication is confident that this change is entirely for the good of the magazine, and sincerely hopes that the changes which appear before the reader will meet with his approval.

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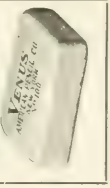

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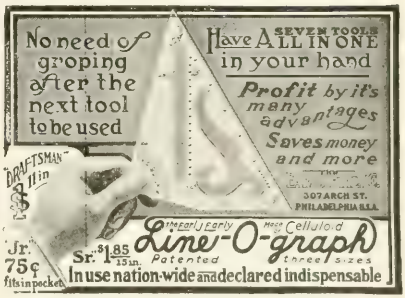
HARVARD ENGINEERING SOCIETY OF NEW YORK

Forty-eight members and guests attended the third regular meeting of the Harvard Engineering Society of New York, held Jan. 23 at the Harvard Club in that city. Henry Goldmark '78, consulting engineer, and formerly designing engineer on the Panama Canal, gave an interesting illustrated talk on the great ditch.

What do you know about the latest sensational automobiles?

Maybe a demonstrator talked to you about them at the Auto Show. If he did, we have additional information; if he did not, it is high time you knew something about them.

The April issue of THE TECHNOLOGY MONTHLY ENGINEERING JOURNAL will contain information which will interest you.



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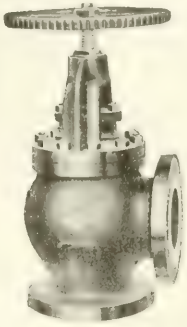

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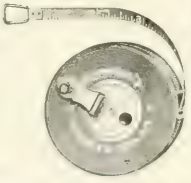

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MY GAWD
DIDJA EVER WONDER WHAT THE COACH THOT OF YUH WHEN YUH TRIED OUT FOR THE SHOW
YA CAN'T BLAME WALT FRAZIER TOO MUCH FOR THESE SISTER ACTS LISTENING TO 19 OF THESE
JAPANESE SWITCH OFF TAP
SPAT VENUES
FRANCIS
AND MEDIATOR
DEVICE
FUNNY BUT MISS TURNER DIDN'T SEE THIS MEN IN THE BALLET
THIS WAY OUT
THE MANAGER AT HIS DESK

CONCERNING TECH SHOW

NAME PLEASE
A FRESHMAN WHO IS GLAD TO SIGN UP FOR TECHNIQUE
A TECH SHOW MAN WHO KNOWS WHEN TO STOP
A FRESHMAN WHO LIKES GYM
A MAN WHO LIKES TO REGISTER
A MAN WHO STAYS AWAKE IN CHEM LECTURES
THIS BOOB GOT "C" IN APPLIED
MAN WHO ARGUED WITH A TECH PROFESSOR
A MAN WHO STARTED TO TELL FRANK KANDY HE WAS GOING TO TRUCK TO HIM

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